A Synopsis

of the proposed thesis entitled

' Laminar Convection Flows of Fluid In Vertical channel'

Submitted to the

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In

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Submitted by

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1.Intoduction

The study of great impact convection in a single and activities two component and fully saturated porous medium has attracted considerable interest in recent years because of its importance in many practical fields such as chemical engineering, geothermal, oil recovery technique and biological process. It is also of practical interest in heat removal the extraction of geothermal energy and more specifically in understanding the mechanism of transfer of heat from aquifers in the deep interior of earth to shallow depths. The mixing process in petroleum reservoirs, regarded as fixed bed reactor is achieved by thermal convection. The study of this convection has many technological applications, for example, the evaluation of the amount of from a hypothetical accident in a nuclear reactor, the prevention of convection and consequent freezing in roads and railways providing effective insulation and so on.

In this research work effective laminar convection flows in a vertical double passage channel containing permeable fluid will study analytically using method of solution. The channel is divided into two passages by means of a thin, perfectly conductive baffle and the walls are uniform.

2. LITERATURE REVIEW

Recently many investigations have been focused on the baffle walled channel heat exchangers. Most studies discussed the optimal baffle geometry that enhance heat transfer performance for a given pumping power or flow rate. In the experimental efforts Founti and J. H. Whitelaw used LDA to deduce the velocity field in an asymmetric heat exchanger with baffles on the shell side surface. [1] The similar distributions of the mean flow velocity and turbulent intensity were found after two sets of baffles from the channel entrance. And Berner et al. (1984b) obtained experimental results of mean velocity and turbulence distributions in flow around segmented baffles.

The first experimental work on the use of permeable baffles, instead of solid plates, was presented by Hwang.[2] In that work, the author found out that heat transfer between the channel walls and the fins was enhanced, showing that for turbulent flow the use of porous baffles benefited heat transfer, i.e., the use of porous baffles in substitution to solid (impermeable) material represented a net gain. To collaborate Hwang's (1997) conclusion, Ko and Anand [3] carried out an experimental program for turbulent flow with porous baffles made

of various materials. However, results (of Ko and Anand) were not very promising. In their analysis, the porous baffles presented in most cases have a flow behavior as good as the one with solid baffles. Celebi and Akyildiz [4] have simulated the problem of fluid motion in partially filled rectangular tanks using the volume of fluid formation to track the free surface. They solved the complete Navier Stokes equation in primitive variables by the use of the finite difference approximations. A mechanical model of liquid sloshing was developed by Xu L and Dai L [5] to investigate the longitudinal dynamic characteristics of partially filled liquid cargo tank vehicles during typical straight line driving. The dynamic liquid motion is modeled by using a mechanical system that describes the behavior of the liquid motion as a linear spring mass model augmented with an impact subsystem for longitudinal oscillations. Computer simulation of tank vehicles under rough road conditions is performed by incorporating the forces and moments caused by liquid motion into the pitch plane vehicle model. Usually, the sloshing effect is suppressed in a passive manner by introducing additional substructures called baffle or sloshing damper into the containers by Gedikli and Erguven, [6] Cho and Lee [7] demonstrated that the shape and design concept of the sloshing damper varies depending on the sloshing motion type, the kind of external excitation and the container shape.

Many practical problems in fluid mechanics require analysis of the behavior of the contents of a finite region in space (a control) volume. For example, we may be asked to calculate the anchoring force required to hold a jet engine in place during a test. The bases of this analysis method are some fundamental principles of physics, namely conservation of mass, Newton's second law of motion and the laws of thermodynamics. [8, 9] Thus, as one might expect, the resultant techniques are powerful and applicable to a wide variety of fluid mechanical circumstances that require engineering judgment.

3. Objectives of Research:

- To study the heat and mass transfer over vertical channel for fluid in different circumstances.
- To study the effects of baffle at different positions.
- To study the effects of different media in vertical channel.

4. Methodology:

For the above mentioned study, first of all we have to study different type of fluids and the governing equations for velocity, temperature and concentrations and their properties.

The basic governing differential equations of the flow and heat transfer are solved using the following techniques.

1) Power Series Method.
2) Regular Perturbation method.
3) Finite Difference Method.
4) Shooting Method.

Study of the effects at different positions of baffle, of different media and fluids will be done by graph which will be plotted using the programming software.

5. Importance of Study:

In the World economy, different forms and types of energy plays vital role at different steps. And today it is a human need to save energy and use it efficiently for more development and for his future generations. The shell and tube heat exchanger is the most common heat exchanger type; therefore the study of its design, optimization and analysis is of great importance for conserving energy in heat exchange process. [10, 11] Heat exchangers are used to transfer thermal energy between two or more media and widely applicable to chemical industries, food industries, power engineering and so on.

The design of two fluid heat transport systems for space applications requires knowledge of heat and mass transfer processes and fluid mechanics under reduced gravity conditions. Identification of the two fluid flow regimes and determination of the pressure drop, void fraction quality relation and two fluid heat transfer coefficients are of great importance for the design of two fluid systems. [12,13] The purpose of the our study focuses on the fully developed convection flow in a vertical double passage channel in the presence of first order chemical reaction, at different baffle positions, are considered so as to extensively investigate their distinct influence on the velocity, temperature, concentration, species concentration, velocity gradient and volumetric flow and rate of heat transfer. [14, 15]

6. Proposed Work Plan/Formulation and Structure of Study:

Year wise plan and target to be achieved.

1. **First Year :**

In the first year the researcher tries to buildup the necessary background the area of research and getting a broad view about research work. Researcher surveys the literature related to research topic and will collect material for research such from research journals, books, research articles, Online sources, different solve and unsolved problems etc. And learn the programming software. And complete course work and course work examinations.

2. **Second Year**:

Collected material will be analyzed to find out directions of research .Different methodology tools techniques will be used in this stage for solving the new research problems. Researcher will use the programming software. Researcher will published her research findings in National and international journals. The researcher will visit to libraries, prominent mathematician to verify her findings. And researcher will attend some Seminar/conference.

3. **Third Year :**

The outcomes of our research work done will be present in national and international Conferences during this year. And submit final Synopsis and thesis to University.

7.References:

1) **Founti, M. A. and Whitelaw, J. H.,** Shell side flow in a model disc and doughnut heat exchanger, Tech. Report FS/81/37, Mech. Eng. Dept., Imperial College, London, UK, 1981.
2) **Hwang, J. J.,** Turbulent heat transfer and fluid flow in a porous baffled channel, 355, ***J. Thermophys. Heat Transfer,*** Vol. 11, pp. 429-436, 1997.
3) **Ko, K. H. and Anand, N. K.,** Use of porous baffles to enhance heat transfer in a rectangular channel, ***Int. J. Heat Mass Transfer,*** Vol. 46(22), pp. 4191-4199, 2003.
4) **Celebi, M. S and Akyildiz, H.,** Nonlinear modeling of liquid sloshing in a moving rectangular tank, ***J. Ocean Eng.,*** Vol. 29, pp. 1527-1553, 2002.
5) **Xu, L. and Dai, L.,** A mechanical model for dynamic behavior of large amplitude liquid sloshing in partially filled tank vehicles, Proceedings of IMECE'03, ***ASME Int. Mech. Eng. Congress,*** Vol. 1(2), pp. 899-904, 2003.
6) **Gedikli, A. Erguven, M. E.,** Seismic analysis of a liquid storage tank with a baffle, ***J. Sound Vib.,*** Vol. 223, pp. 141–155, 1999.
7) **Cho, J. R. and Lee, S. Y.,** Dynamic analysis of baffled fuel-storage tanks using the ALE finite element method, ***Int. J. Num. Methods Fluids,*** Vol. 41, pp. 185-208, 2003.
8) **Mackley, M. R. and Ni.,** Mixing and dispersion in a baffled tube for steady laminar, doi:10.1016/0009(91)85017, 2001.
9) **Mahdi Shahrokhi., Fatemeh Rostami, Md Azlin., Md Said and Syafalni**, Numerical modeling of the effect of the baffle location on the flow field, sediment concentration and efficiency of the rectangular primary sedimentation tanks, ***World Applied Sciences***

Journal, Vol. 15, pp. 1296-1309, 2011.

10) **Maheshwari, B. K., Rajendra Karwa and Gharai, S. K.,** Performance study of solar air heater having absorber plate with half perforated baffles, ISRN Renewable Energy, Article ID 634025, doi:10.5402/2011/634025, 2011.
11) **Nelson, D. J. and Wood, B. D.,** Combined heat and mass transfer natural convection between vertical parallel plates, ***Int. J. Heat and Mass Transfer,*** Vol. 32, pp. 1779 - 1787, 1973.
12) **Prathap Kumar, J., Umavathi, J. C. and Prema, H.,** Free convection of Walter's fluid flow in a vertical double passage wavy channel with heat source, ***Int. J. Eng. Sci. and Tech.,*** Vol. 3(1), pp. 136-165, 2011b.
13) **Radhakrishnamacharya, G**., Some flow problems in bio-fluid dynamics, Ph.D. thesis, IIT Kharagpur, 1978.
14) **Prathap Kumar, J., Umavathi, J. C. and Jagtap Sharadkumar.,** "Effect of first order chemical reaction in a vertical double passage channel", ***International Journal of Engineering Research and Application,*** Vol. 3(5), pp. 967-977, 2013.
15) **Prathap Kumar, J., Umavathi, J. C. and Jagtap Sharadkumar**, "Heat and mass transfer for a chemically reacting permeable fluid in a vertical double passage channel", ***International Journal of Engineering Research and Technology,*** Vol. 2(10), pp. 1117-1143, 2013.

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